

# Effect of Cutting Speed on Surface Quality by Bandsawing

Yu Jianguo (于建国)

Northeast Forestry University, Harbin 150040, P. R. China

Liangkai TING

Department of Science and Engineering, Shimane University, Japan

**Abstract** The surface profile behavior of workpieces sawn has been investigated. Six species were sawn under the condition of four different kinds of cutting speed by the band saw. The real surface profile of a sawn workpiece is composed of two sections, which are the additivity of the waviness of filtered wave and roughness curve. The roughness of center line average as well as amplitude decrease with the increasing of cutting speed for different kinds of species used in the experiment.

**Key words:** Band saw, Cutting speed, Profile curve, Waviness of filtered wave, Roughness curve, Roughness of center line average

## Introduction

Since the band saw can be quickly and accurately set and there is virtually no upper-size limit in log diameter, the machine can be regarded as the most effective all-round machine. Lumber mills show growing interest in the bandsawing concept due to the high throughput and improved yield, even where other saw types have traditionally predominated. The main problem when using a bandsaw at high feed rates and cutting speeds has been that the thin flexible saw blade could be laterally deflected in the timber. The saw blade then went into oscillation. The result of this was that the wood emerged from the saw with a wavy surface that had to be planed, thus reducing the advantage of the narrow kerf. So, how to improve the sawing accuracy is great important in the log conversion process. Decreasing kerf losing and improving surface quality of wood materials has been become an increasing concern to the wood processing industry. To learn more about the effect of cutting speed on the surface quality by bandsawing, a series of cutting experiments were done at the laboratory of the Department of Science and Engineering, Shimane University, Japan. Some of the results have been investigated.

## Material and Method

Sawing experiments were conducted using a 700 mm bandmill produced by Japan (Fig. 1). The band blade has the following dimensions: length 4700 mm, width 51 mm,

and thickness 0.8 mm. Tension stress of band blade was 36.2 N/mm. A variable cutting speed were used from the 7.3 m/s, 14.7 m/s, 22.0 m/s to 20.3 m/s and the feeding speed of workpiece was 3m/min. The roughness of center line average and the amplitude of profile curve of the sawn workpieces were measured with the surface texture measuring instrument. Six wood species were used in the experiment as shown in Table. 1.

**Table 1 Physical characters of wood species**

Wood species	Specific gravity	Moisture content (%)	Vessel distribution
Softwoods			
1 <i>Cryptomeria japonica</i> D Don	0.33	11.7	
2 <i>Picea jezoensis</i> Carr	0.43	12.2	
3 <i>C. lawsoniana</i> Parl	0.45	12.4	
Hardwoods			
4 <i>Magnolia obovata</i> Thunb	0.48	10.5	D
5 <i>Cornus controversa</i> Hemsl	0.61	13.7	D
6 <i>Quercus serrata</i> Thunb	0.78	11.6	R

Legends: D: Diffuse-porous, R: Ring-porous

## Results and Discussion

Typical profiles of sawn workpieces with the four different kinds of speed are shown in Fig. 2. The meaning of the curves in Fig. 2 is being explained as following:

Profile curve -- A contour appears on a cut end, when a surface to be measured has been cut with a plane which is

perpendicular to that surface.

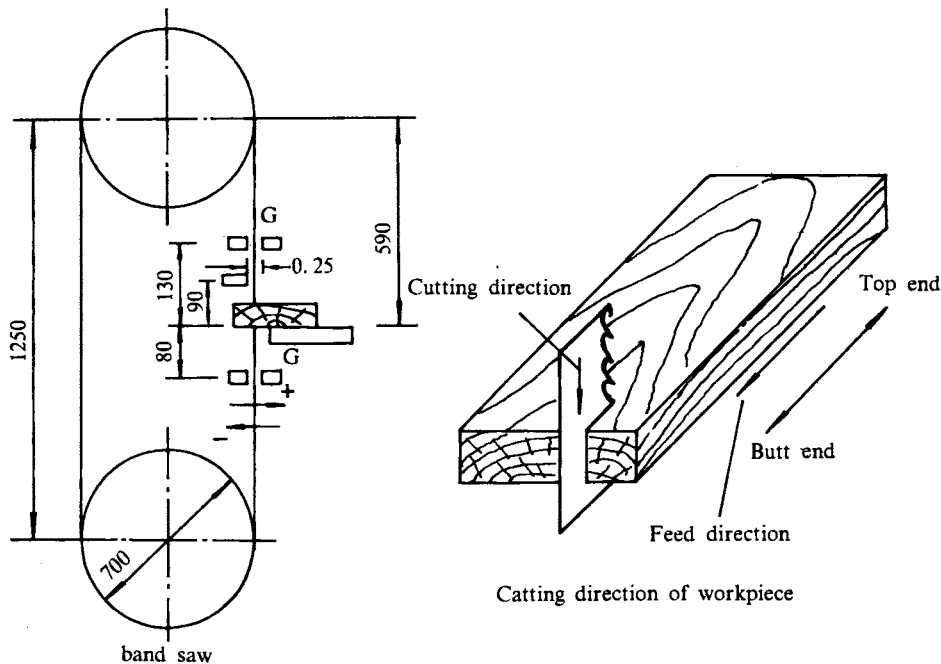


Fig. 1. Experimental apparatus and cutting direction of workpiece.

Legends: +: Outside of machine, -: Inside of machine, G: Guide.

**Roughness curve** -- A curve which has been cut off any longer surface waviness component than a prescribed wavelength from the profile curve by means of phase compensation type high-pass filter.

**Waviness of filtered wave** -- A curve made by cutting off the component of surface roughness shorter than a given wavelength from the profile curve by means of phase compensation type low-pass filter. (Fig. 3).

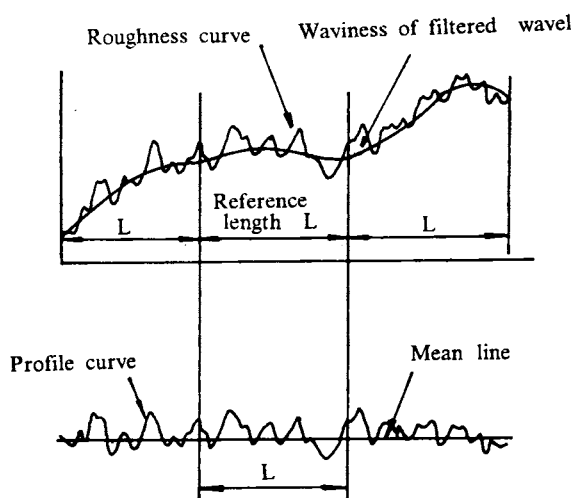


Fig. 2. Explanation on profile curve, roughness curve and waviness of filtered wave

The relationship between the cutting speed and  $R_a$  for six species is shown in Fig. 4. The positive side means the  $R_a$  measured from the sawn workpiece which is located at the outside of the bandmill. The negative side means the  $R_a$  measured from the sawn workpiece which is located at the inside of the bandmill. The results changed as follows with increase of cutting speeds: whether the sawn surface of workpiece at positive or negative side, the  $R_a$  decreases with the increasing of cutting speed. The finish of the wood surface at positive side workpiece is a little better than that of at negative side workpiece.

Fig. 5 shows the relationship between cutting speed and amplitude of profile curve of six species. It is easy to see that there a similar result to the Fig. 4. Cutting speed is a main factor influenced the surface quality of workpiece. There is also a different result of quality between the positive and negative side of the workpiece.

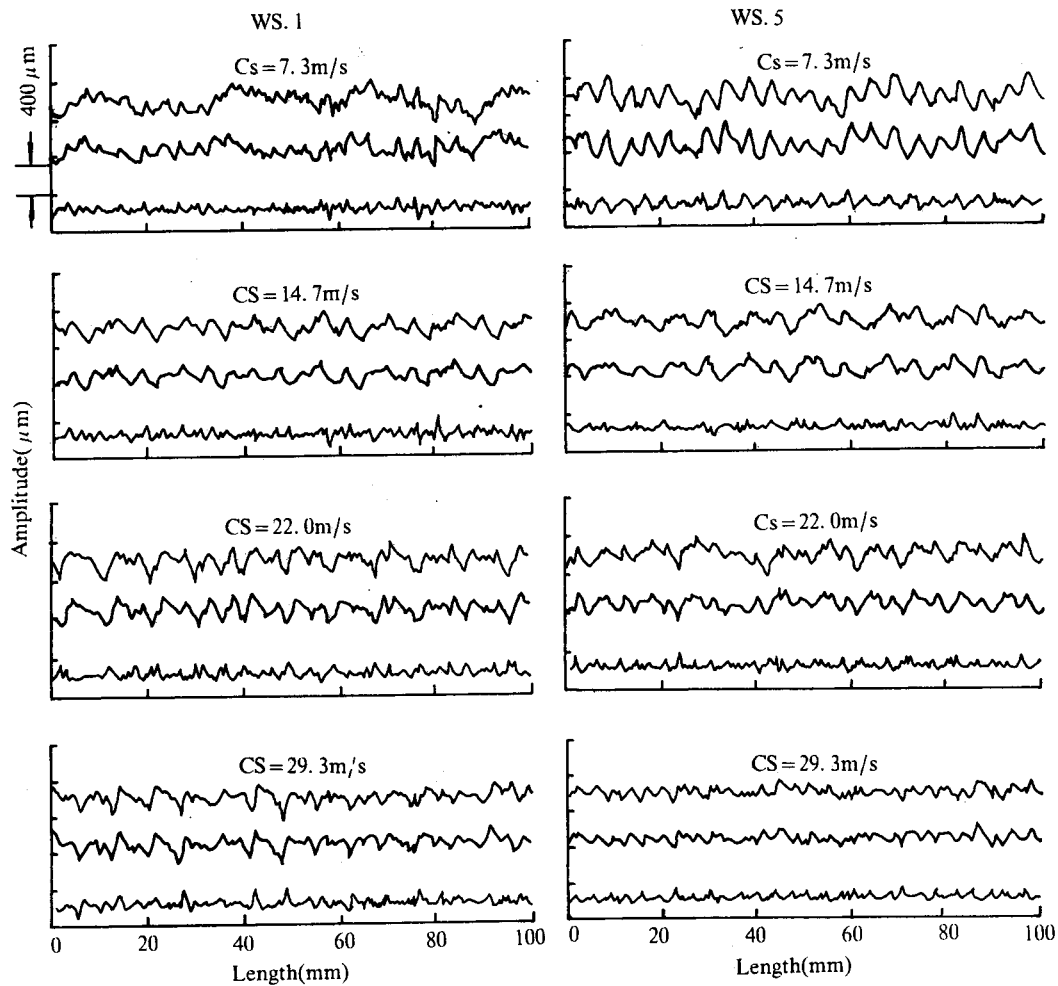


Fig. 3. Various types of profiles

Legends: — Profile curve. - - - Waviness of filtered wave. ... Roughness curve. CS: Cutting speed. Note: Feed speed: 3m/min. WS: Wood species

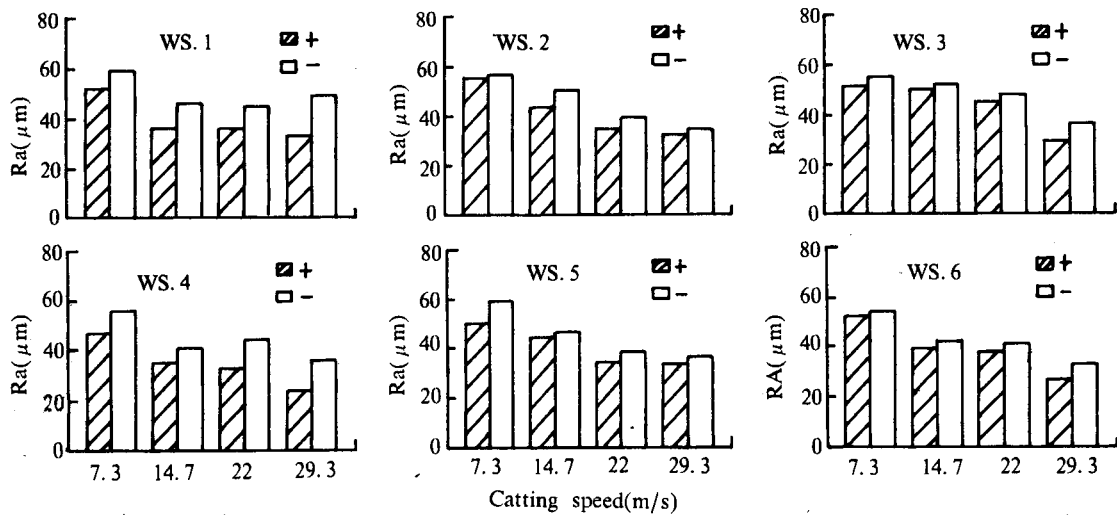


Fig. 4. Relationships between cutting speed and Ra for 6 wood species

Legends: + and -: Same as in Figure. 1. Note: Ra: Roughness of center line average. WS: Wood species

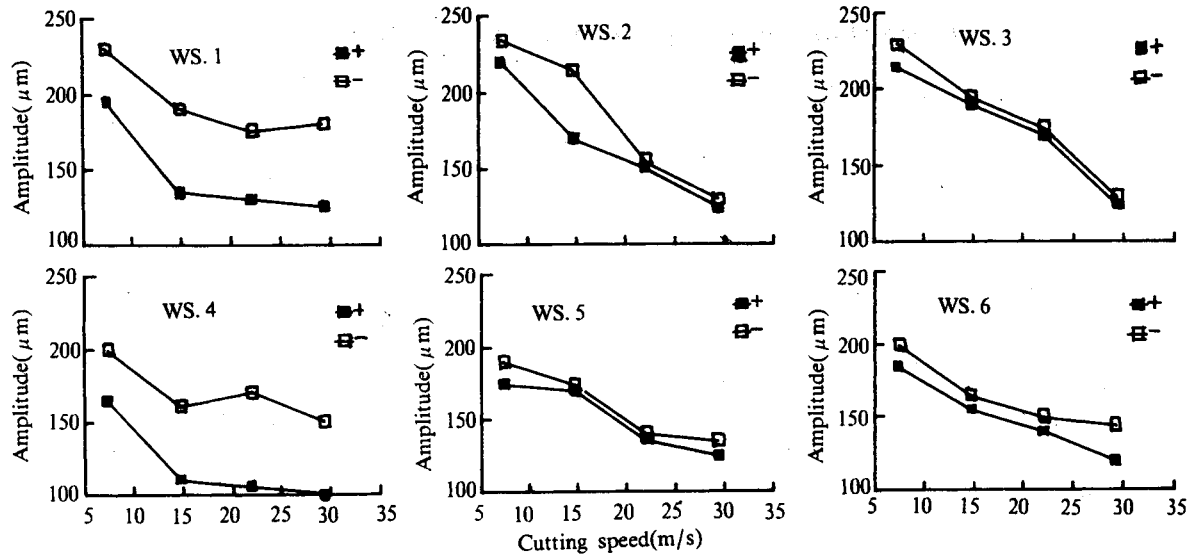


Fig. 5. Relationships between cutting speed and amplitude of curve for 6 wood species

Legend: + and - Same as in Figure 1 WS: Wood species

## Conclusion

Real surface profile of a sawn workpiece is composed of two sections, the additivity of the waviness of filtered and roughness curve. The waviness of filtered is similar to the rule of a sinusoid and the roughness curve is similar to the rule of a random. The surface quality of the workpieces between the band blade is a little different. The roughness of center line average as well as the amplitude of the sawn workpieces decrease with the increasing of cutting speed on all of the species used in the experiment.

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